Space Weather Technical Forecast

Issued on Wednesday 23 October 2024 at 13:18 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Increasing chance of Radio Blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity observed at GOES16 and 18 was Low with only occasional minor C-class flares, peaking at C5.1 at 22/1211 UTC.

Solar activity has been Low with only C-class flares observed, the largest a C5.1 at 23/0026 UTC from a region behind the southeast limb. There remains a chance of isolated Moderate flares, most likely from the regions indicated to be close to, or approaching, the eastern limb (such as Ex-AR3842).

A filament eruption occurred around 22/1715 UTC in the northwest quadrant. This filament was small but an associated CME was generated. Analysis has proven complex but the bulk of the ejecta is expected to not be Earth directed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, were indicative of a slow regime with weak coronal hole influence. The solar wind speed ranged from 290 km/s to 360 km/s on a slight rising trend. The solar wind density rose form average levels to above average levels after 22/2000UTC, with a peak of 28ppcc at 23/0639UTC. The IMF was at weak levels to start, but became moderate at times after 23/0100 UTC, with a peak of 12nT at 23/0330UTC. The north-south component was weak, rangeing from -7 to +6 nT. The phi angle was positive (Away from the Sun) throughout. The net result of the above solar wind measures was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was mainly at Normal Background levels, but with a Moderate peak of 291pfu at 22/1440 UTC. The associated 24-hour fluence was well below the Active threshold. The 23/0000UTC observation was 3.22e6 integrated pfu with a gradual downward trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is Likely to be Low, with a Chance of Moderate activity from isolated M-class flares initially, until new or returning regions rotate onto the visible disc. Several notable active regions may arrive from behind the eastern limb, potentially increasing the solar activity later in the period.

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Solar Wind / Geomagnetic Activity: Currently there are no Earth-directed CMEs in the forecast, although a CME from the small filament eruption in the northwest on the 22nd Oct may give a slight chance of a glancing blow later in the period. CH82/+ was weaker than expected, with waning effects lingering through day 1 into day 2 (23/24 Oct). The next HSS arrival is from CH84/-, which is near centre disc, day 3 or day 4 (25th or 26th). Overall background solar winds are expected to predominate, with mainly Quiet to Unsettled (Kp 0-3) geomagnetic activity, and just a slight chance of Minor/G1 geomagnetic storm levels (Kp 4-5) being reached at times later in the forecast period.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is Expected to remain at Background levels.

High energy electron flux at GOES16 is forecast to remain at mainly Background to Moderate levels, with the associated 24-hour fluence Expected to remain below Active (1e8 total pfu) throughout.

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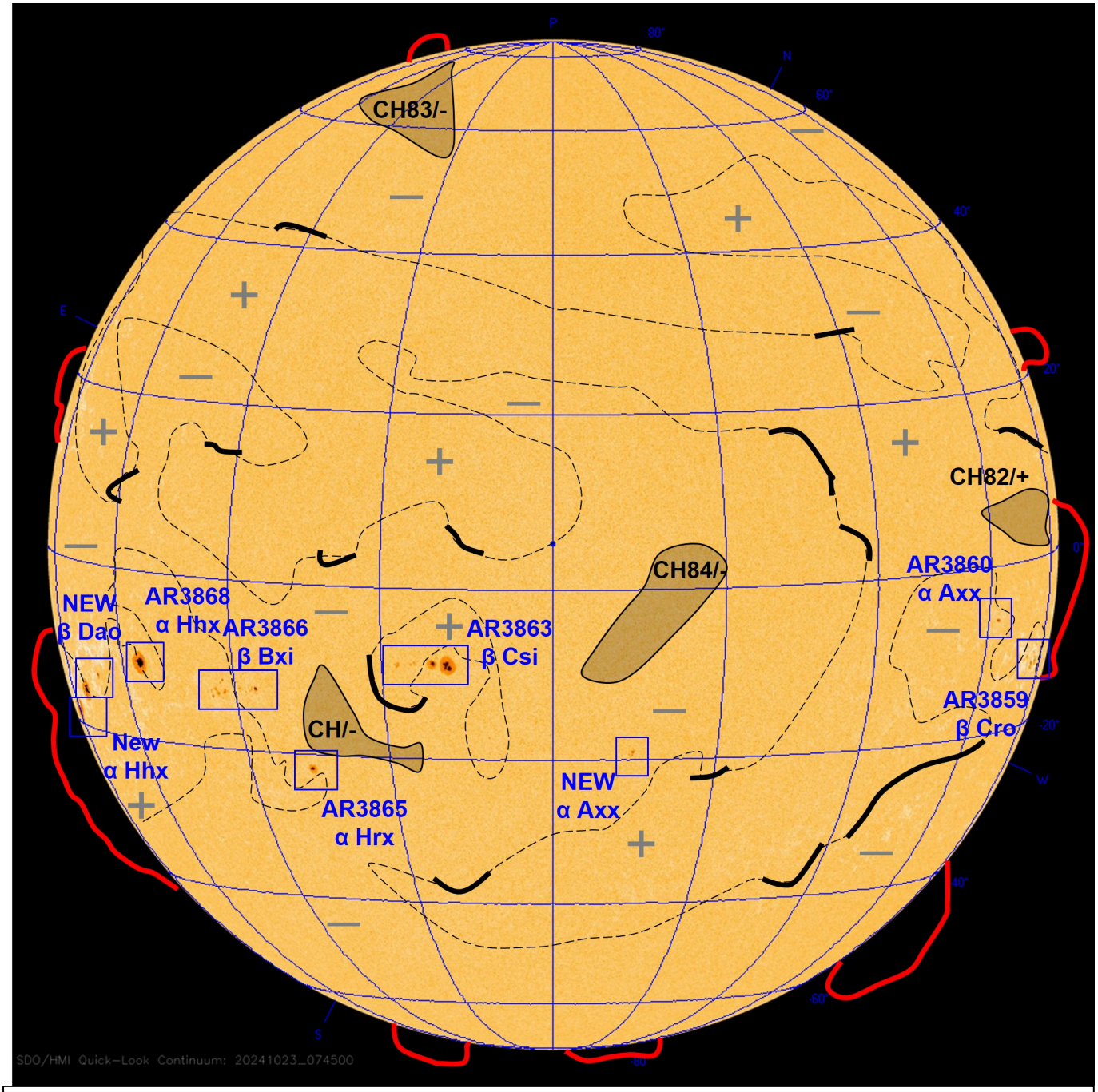
Figure 1: Solar synoptic map valid 23/0745UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth-directed CMEs currently feature in the forecast, although there is potential for a glancing blow from the filament eruption CME in the northwest quadrant in the 22nd, perhaps day 3 (25th) or during day 4 (26th). However, most of the CME material is likely to miss Earth.

Solar winds are currently at Background levels with waning effects from CH82/+. MOSWOC Enlil model output does show a solar wind enhancement from late today. This may be due to a very late HSS arrival from CH82, or more likely from a HSS associated with CH84. This coronal hole is a recurrent coronal hole, currently just west of centre disc, and is marginally more substantial compared to the previous rotation when slightly elevated winds occurred but no significant geomagnetic activity. Enlil's expectations of the HSS is considered to be 24-48 hours too early.

Geomagnetic activity is forecast to be predominantly Quiet to Unsettled (Kp 0-3) but with a slight chance of G1/Minor geomagnetic storm intervals occurring later in the period, due either to a glancing CME arrival or a HSS connection.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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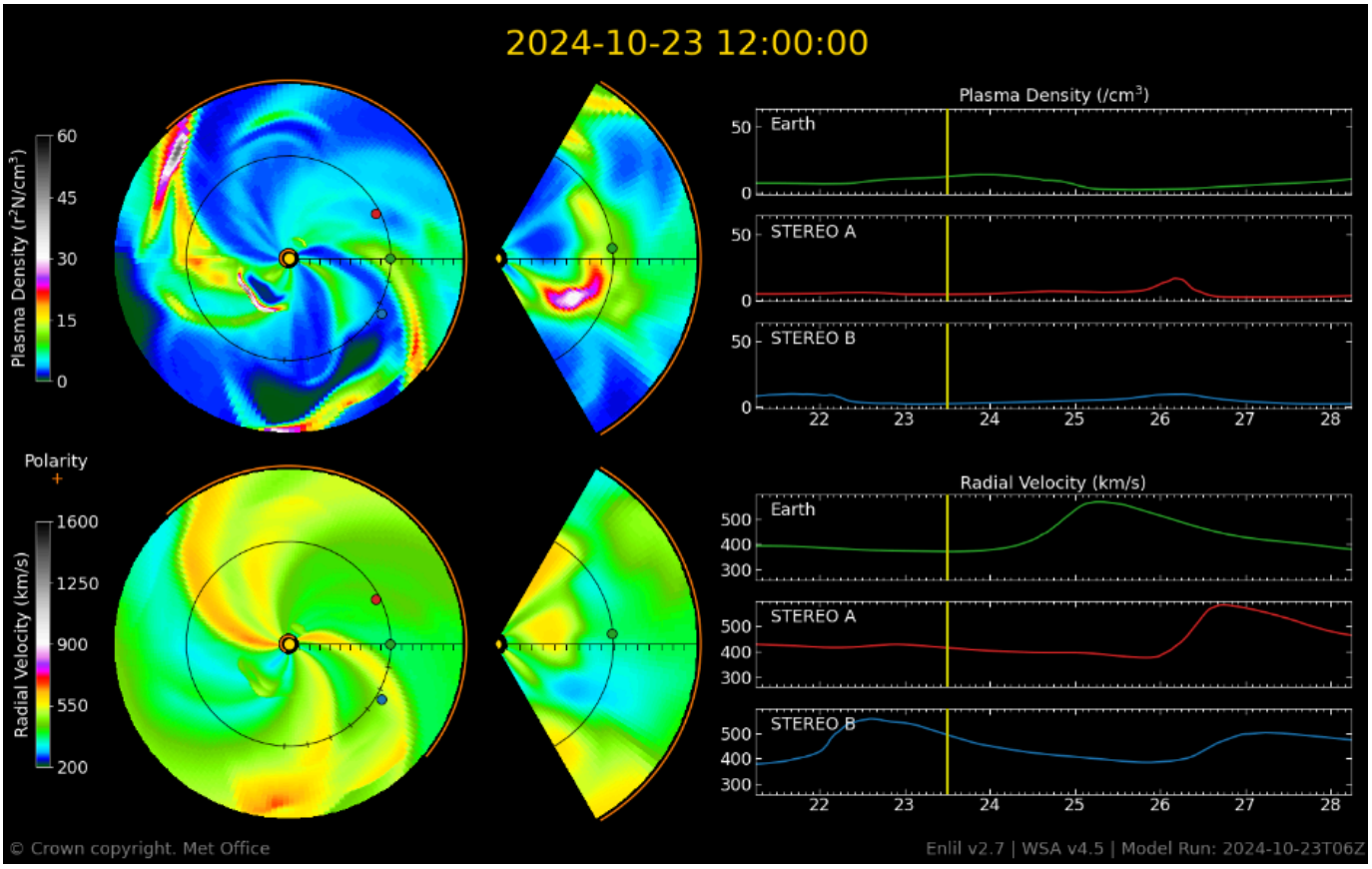
Figure 2: MOSWOC Enlil



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Radio Blackouts - X-Ray Flares

There are six numbered and three unnumbered sunspot regions on the visible disc, all of which appear magnetically simple, stable or have shown slight decay. The only regions of slight note are AR3863, AR3868 and the two new regions near the southeast limb due to their apparent moderately or large sized penumbra in their main spots. All other spots are small and AR3857 faded to plage.

Activity is expected to increase in the coming days, as recurrence, recent CME activity, and far-side sounding data all suggest the return of several active regions that were present on the disc earlier in October. Bright looping is evident near the eastern limb in SDO AIA171 imagery, with recurrence suggesting the return of Ex-AR3842, previous source of several strong flares (including SC25's peak X9.0 flare on 03 October) through the forecast period. As such, activity may increase to Moderate, with the chance of M-class flares increasing through the period.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	25	30	40	40
Very Active	R3-R5 (X Class)	No	5	5	10	10

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Figure 3: 24 hour X-ray trace

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Figure 4: SDO 171 imagery

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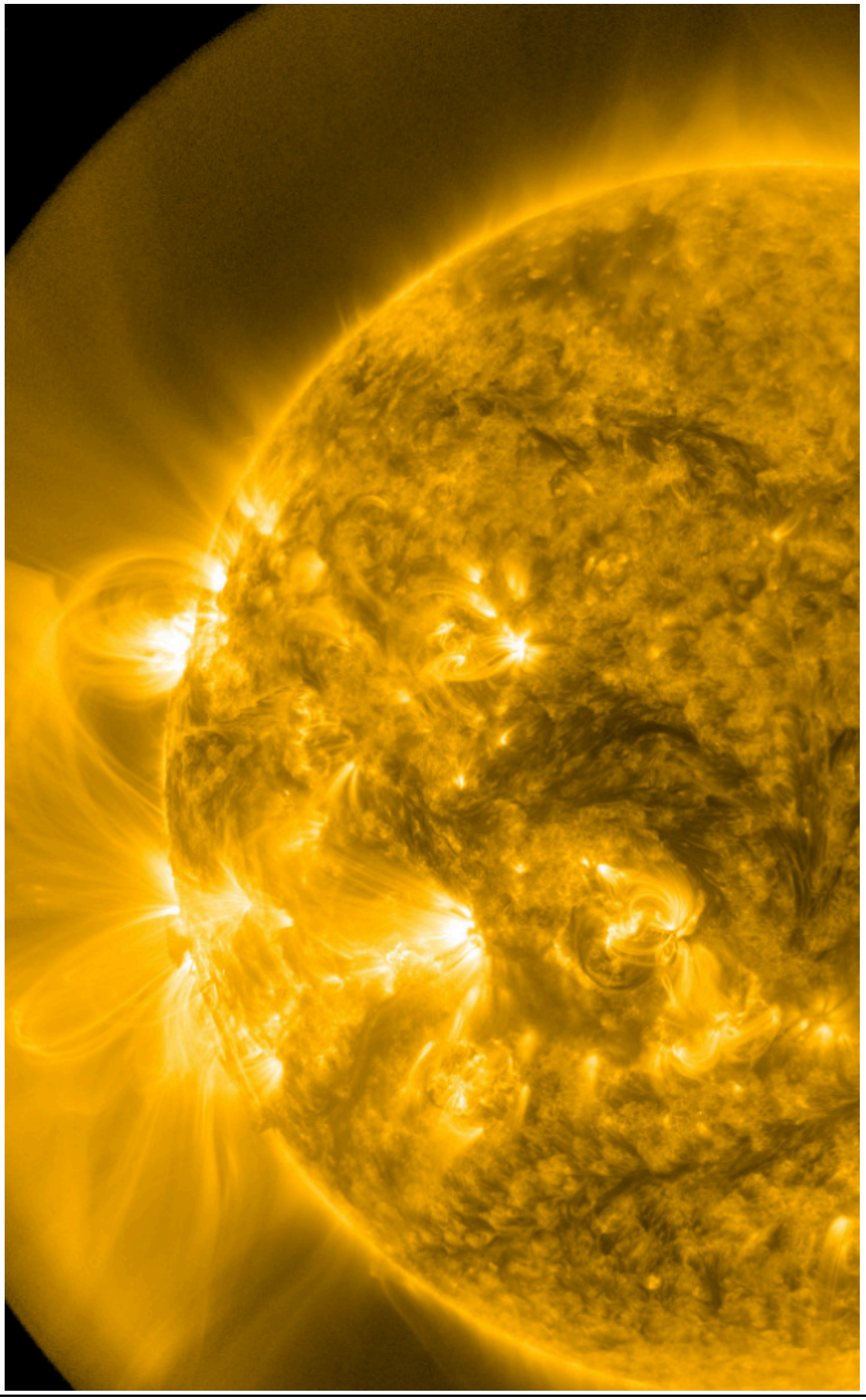

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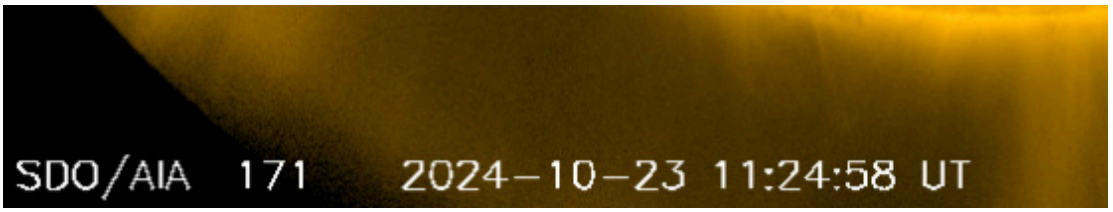

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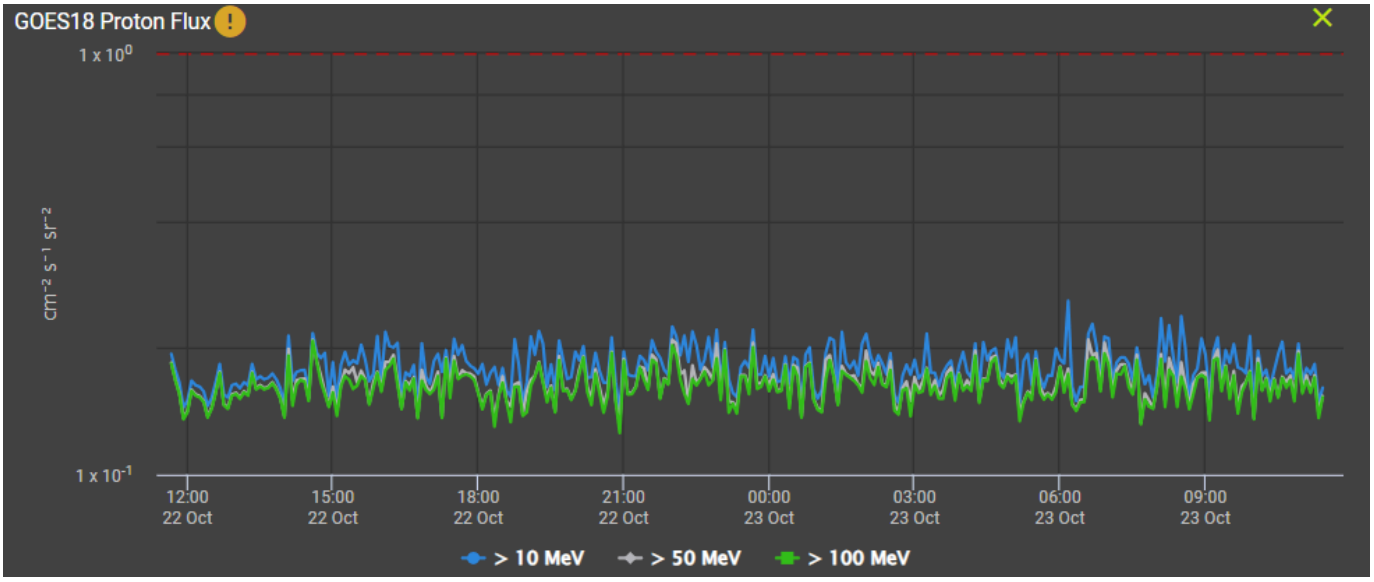
Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at Background levels.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5:



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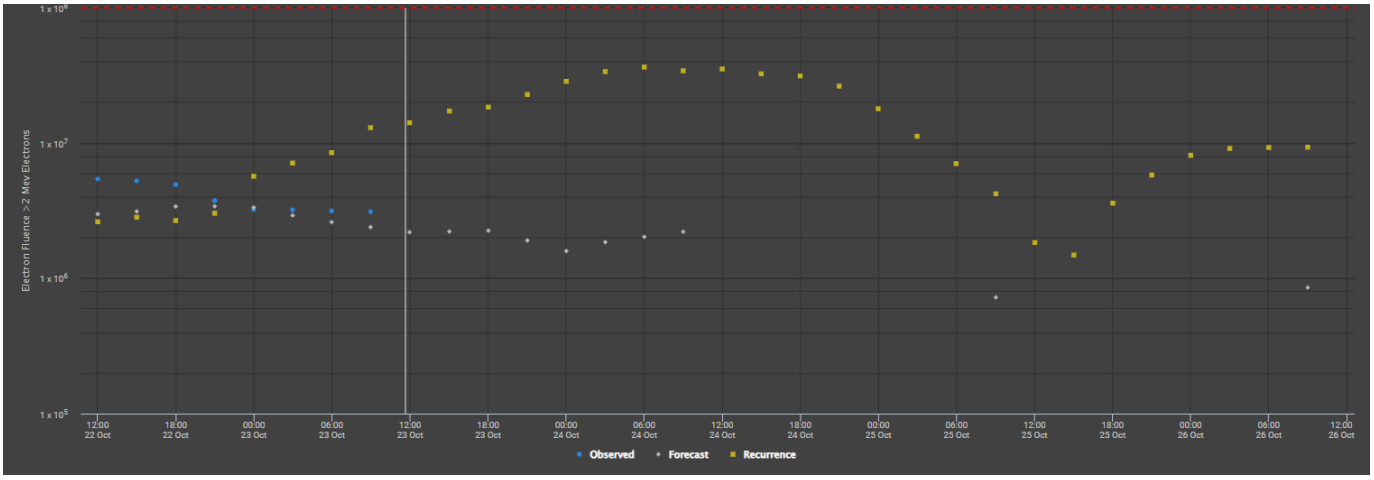
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 has mainly been at Normal Background levels, with only brief incursions above the Moderate threshold at diurnal peak, with a similar trend expected to continue.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with MOSWOC REFM thought to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 6: MOSWOC REFM fluence forecast/observations/recurrence



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